Monitoring Hemlock Crown Health in Delaware Water Gap National Recreational Area

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ABSTRACT

Decline of the health of hemlocks in Delaware Water Gap National Recreation Area was noticeable in the southern areas of the park by 1992. The following year, a series of plots were established to monitor hemlock health and the abundance of hemlock woolly adelgid. This poster examines only the health rating of the hemlocks in the monitoring plots.

METHODS

Seven sites were selected on the Pennsylvania and New Jersey sides of the Delaware River which runs through the middle of the park. One site, Grey Towers, is just north of the park boundary. The hemlock stands are associated mostly with watercourses that run to the river, often in steep ravines with spectacular waterfalls. Plots were installed from 1993 to 1995; the Donkeys Corner site was added in 1998 (Figure 1). Dunnfield Creek access was difficult and too many measurements were missed, so this site was discontinued and its data are omitted from analysis.

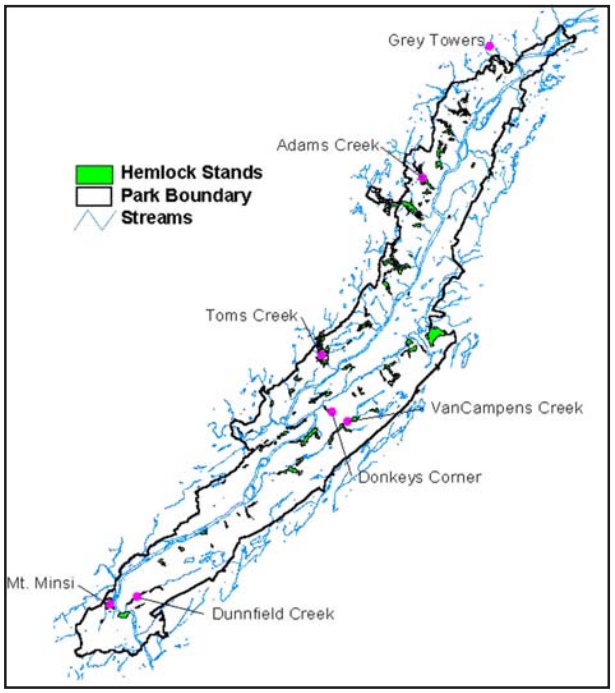

Figure 1. Study sites in the Delaware Water Gap National Recreation Area.

Each site had several plots of 10 living hemlock trees. The number of plots at each site ranged from three to 36, with more plots on larger sites. Diameter at breast height (DBH) and crown position were measured for each tree. Each year (with some gaps), the crown condition was estimated by a trained crew using the "Visual Crown Rating Methods" developed by Forest Service State and Private Forestry (USDA Forest Service, 1998).

Live Crown Condition Indicators

Live Crown Ratio — ratio of live crown to total tree height

Foliage Density — an estimate (percentage) of the fullness of the crown, based on the amount of skylight blocked from view by leaves, branches, bole, and fruits

Foliar transparency — an estimate (percentage) of the amount of light seen through the foliage parts of branches

Crown Dieback — the percentage of branches with newly dead twigs in the live crown

Ratings of the crown were done by a two- or three-person crew standing 15–30 m (50–100 ft) from the base of the tree at various angles with an open view of the crown. The consensus visual estimates were recorded to the nearest 5% for dieback, density, transparency, and live crown ratio. Crown diameter was measured with a tape measure on the ground from one edge of the canopy to the opposite edge; a second measurement was made at right angles to the first.

After completing this formal rating of crown indicators the crew scored the overall health of the hemlock crown into four classes: 1 = severe decline, 2 = moderate decline, 3 = slight decline, and 4 = healthy. Trees with dead crowns were recorded as 0.

Measurements were made on 900 trees. The number of trees measured in any year varied from 201 to 801. Although the sampling of trees from year to year was haphazard, trends in health based on the trees measured each year seem to depict the average condition of hemlock in the park reasonably well. The data presented represent averages for all the trees measured each year and have not been interpolated for missing data. Future work will analyze the data with models and statistical procedures.

RESULTS

The crown condition indicators showed little change from 1993 to 1999 except for crown density, which began its decrease earlier. Dieback of branches showed the greatest change, increasing 4-fold from 6% in 1999 to 23% in 2004. Transparency of the crown increased from 25% to 45%. The live crown ratio showed little change. Figure 2 illustrates these trends.

The overall health rating by the trained observers provided a simple, easily understood "report card" of hemlock health. By 2004, none of the hemlocks were rated completely healthy, only 1% were slightly unhealthy, 64% in moderate decline, 11% in severe decline, and 23% were dead. Although the onset and pace of decline in hemlock health in the park varied among the study sites, by 2004 there were no completely healthy hemlocks in any of the sites (Figure 3). Annual mortality during the last five years was about 3%. The report card for all sites is poor with no sign of improvement.

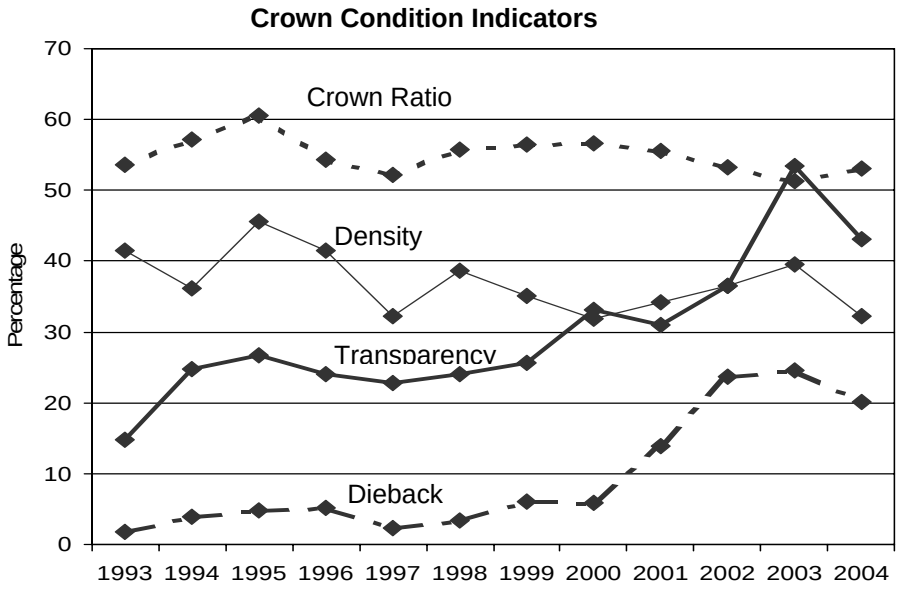

Figure 2. Trends in tree health indicators.

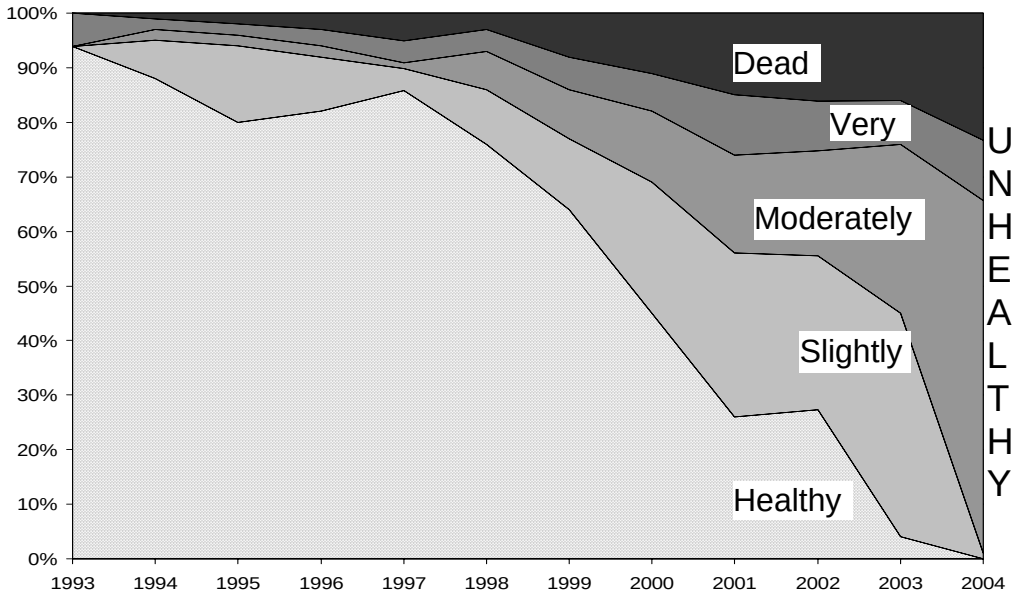

Figure 3. Overall health of hemlocks, 1993-2004.

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